

Orchids of Maharashtra, India: a review^a

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Abstract

A comprehensive account on Orchid diversity of the state of Maharashtra has been made on the basis of field and herbarium studies. The present study revealed the occurrence of 122 taxa (119 species and 3 varieties) belonging to 36 genera from the State, out of which 32% (37 species and 2 varieties) are endemic to India. Special efforts have been made to find out distribution of endemic species and their conservation status. Besides this ecology, habitat and phyto-geographical affinities of the orchids occurring within the state of Maharashtra are also discussed.

Résumé

Révision des orchidées de Maharashtra, Inde – Un bilan détaillé de la diversité en orchidées de l'État de Maharashtra a été réalisé sur la base d'études menées sur le terrain et dans les herbiers. L'étude a révélé la présence dans cet État de 122 taxons (119 espèces et 3 variétés) réparties en 36 genres, dont 32% (37 espèces et 2 variétés) sont endémiques de l'Inde. Un effort particulier a permis de préciser la distribution géographique des espèces endémiques et leur statut de conservation. En outre sont discutés l'habitat et les affinités phyto-géographiques de chaque espèce poussant dans l'État.

Introduction

The Orchidaceae are an unique group of plants, mostly perennial, sometimes short-lived herbs or rarely scrambling vines. They occupy an outstanding

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position among all the flowering plants because of their long-lasting and bewitchingly beautiful flowers and are commonly valued either for cut flower production or as potted plants in ornamental horticulture. The family Orchidaceae is the second largest in the flowering plant kingdom, in recent estimates it comprises *ca.* 27,800 species under *ca.* 736 genera distributed in five subfamilies (Chase *et al.*, 2015; The Plant List, 2015). Orchids are distributed worldwide, except in Antarctica and are most numerous in the humid tropics and subtropics (Chen *et al.*, 2009). However, their distribution is not uniform, even in tropics or in subtropics and it varies widely between continents and within regions. In India the family is represented by *ca.* 1300 species, 5 subspecies and 28 varieties under 186 genera (Misra, 2007).

The mountain chain of the Western Ghats has an exceptionally high level of biological diversity and is recognized as one of the 25 hotspots of the world along with Sri Lanka (Myers *et al.*, 2000). The forests of the Western Ghats include some of the best representatives of non-equatorial tropical evergreen forests in the world. The state of Maharashtra falls in northern part of Western Ghats. Maharashtra harbours *ca.* 5,040 flowering plant species and infraspecific taxa, belonging to *ca.* 1,600 genera and 215 families, of which *ca.* 319 species are endemic to Maharashtra (Almeida *et al.*, 2003). Due to continuous habitat fragmentation by indiscriminate felling of forest trees, clearance of forest cover for expansion of agricultural land, illegal trade for medicinal use and various other anthropogenic activities, the orchid flora of the state has become highly threatened. The present study is aimed to make an up to date account on the orchid flora of Maharashtra which will throw light on its diversity, distribution, habitat specificity and rarity, which will also help in formulating any pertinent plan for conservation action.

Study Area

The state of Maharashtra is located in the western and central part of peninsular India. It lies between 15°40' and 22°00' N latitudes and 72°30' and 80°30' E longitudes. The State is neighboured by the Arabian Sea to the west, Gujarat to the north-west, Madhya Pradesh to the north, Chhattisgarh to the east, Andhra Pradesh to the south east, Karnataka to the south and Goa to the south west. The state occupies a geographical area of 307,713 km² and is the third largest of the country. Approximately 20%

of the total area of the state is under forest cover (Joshi & Sahay, 2013). The vegetation of the state was classified by Champion & Seth (1968) into the following five categories 1. Tropical semi-evergreen forests, 2. Tropical moist deciduous forests, 3. Tropical dry deciduous forests, 4. Tropical thorn forests and 5. Littoral and swamp forests. The State has 35 administrative districts which are divided into six revenue division's viz. Konkan, Pune, Nashik, Aurangabad, Amravati and Nagpur (Fig. 1). On the other hand, based on physical features the state can be divided into three divisions viz. The Maharashtra Plateau, the Sahyadri Range and the Konkan Coastal Strip. The Maharashtra Plateau covers a major portion of the state, it includes many small relatively flat highlands and river valleys. The Western Ghats of Maharashtra known as the 'Sahyadri' mountain ranges have an average elevation of 1000-1200 m above the MSL. The Sahyadri hills run parallel to the seacoast, with many offshoots branching eastwards from

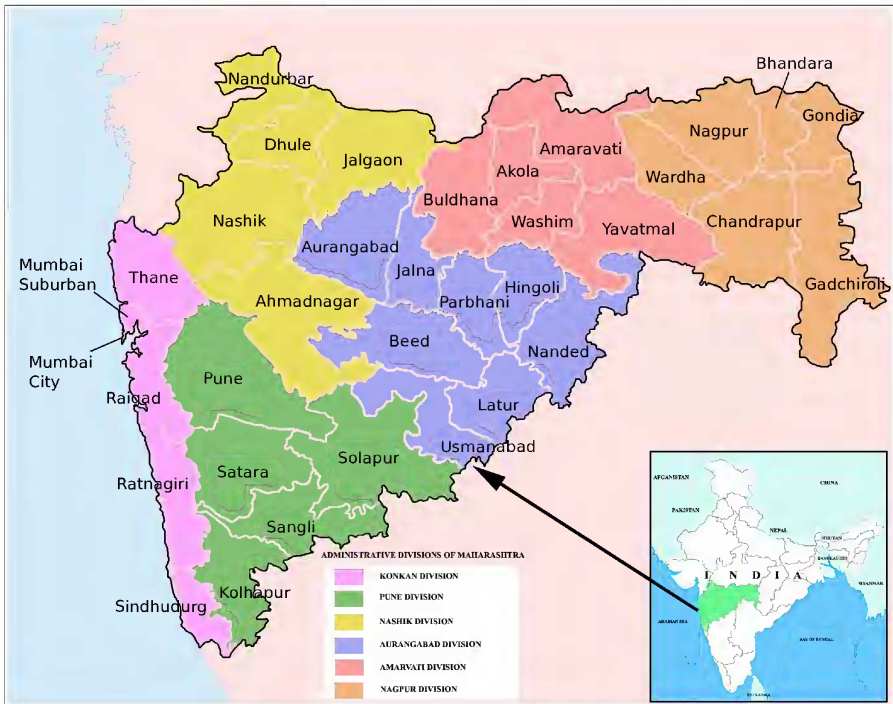


Fig. 1: Administrative map of Maharashtra State, India
showing different Divisions and Districts.

the main ranges. Its highest peak is “Kalsubai” at an altitude of 1650 m. Most of the rivers in Maharashtra originate in the Sahyadri and then divide to join the eastward and westward flowing rivers. The narrow strip of coastal land between the Sahyadri and the Arabian Sea is called the Konkan coastal strip. It is approximately 720 km in length and barely 50 km in width; it is wider in the north and narrows down in the south (Fig. 2). The climate of the state is tropical and it experiences four seasons during a year.

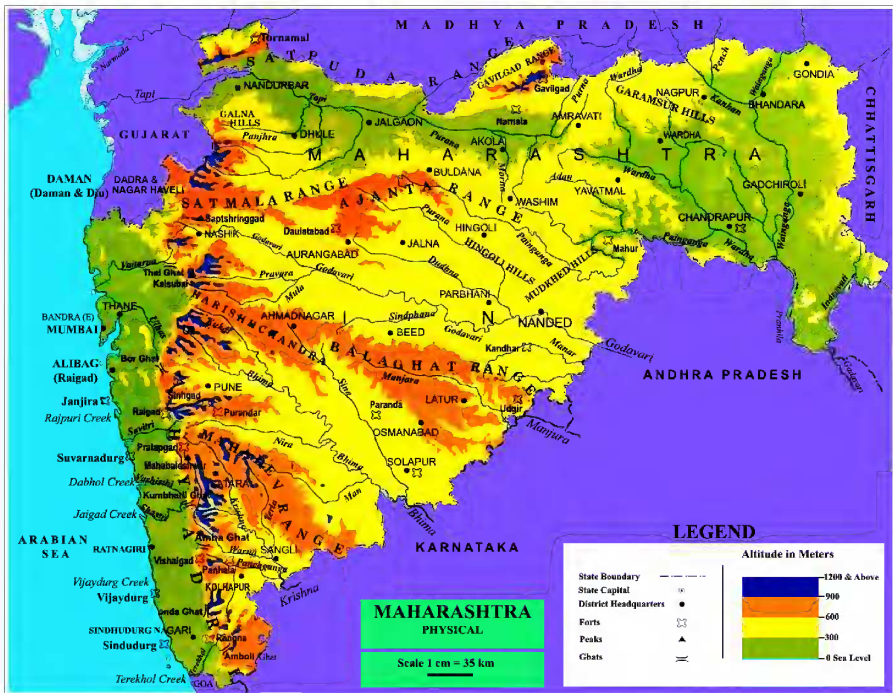


Fig. 2: Topographic map of Maharashtra State.

March to May is the summer season followed by rainy season from June to September. The post monsoon season is October to November and December to February is the winter. Maharashtra receives its rainfall mainly from the south-west monsoon. Rainfall starts in the first week of June and July is the wettest month. The amount of rainfall varies considerably from place to place. The Konkan sub-division comprising of coastal districts and Western Ghats receive the heaviest rains, the Ghats receive more than 6000 mm and the plains 2500 mm. Rainfall decreases

rapidly towards the eastern slopes and plateau areas where it is minimum, less than 500 mm. The temperature of the State varies between 10°C in the winter and 43°C in the summer and relative humidity varies between 40-85%.

Review of Literature

The flora of Bombay and its vicinity was compiled for the first time by Graham in 1839. Graham reported the occurrence of 32 species of orchids under 11 genera. Dalzell (1850-52) has described several new species of orchids for the first time from the then Bombay region. Later, Dalzell & Gibson (1861) have attempted to list all indigenous and introduced flora of Bombay. They listed 57 species of orchids under 23 genera. Gammie (1905-1912) reported 60 species under 30 genera from the then "Presidency of Bombay". Cooke (1907) in "*The flora of the Presidency of Bombay*" reported *ca.* 75 species belonging to 31 genera. Blatter & McCann (1931-32) have revised the family Orchidaceae and during their revision they described several new species from the area. Later, Santapau & Kapadia (1959-1963 & 1966) found *ca.* 120 species of orchids belonging to 36 genera occurring in the Bombay state of which only 86 species belong to the present day Maharashtra.

Later, Ugemuge (1986), Kamble & Pradhan (1988), Kulkarni (1988), Almeida (1990), Mudaliar (1991), Lakshminarasimhan & Sharma (1991), Kothari & Moorthy (1993), Deshpande *et al.* (1995), Yadav & Sardesai (2002), Punekar (2002), Sardesai *et al.* (2002), Pradham *et al.* (2005), Bachulkar (2010), Bachulkar-Cholekar & Bhoiete (2012), Datar & Ghate (2012), Muratkar *et al.* (2013), Yadav & Sharma (2013), Cerejo-Shivkar & Shinde (2015) made contributions to the orchid flora of some districts and protected areas.

As for the orchid flora of the State, Lakshminarasimhan *et al.* (1996) reported 105 species and 3 varieties under 34 genera. Sardesai & Yadav (2004) has revised the genus *Habenaria* Willdenow. Almeida (2009) enumerated 147 species and 10 varieties (including cultivated species), Pande *et al.* (2010) were able to report only 99 species of orchids occurring in wild in North Western Ghats (including Maharashtra, Goa and Belgaum) and finally Jalal & Jayanthi (2012) reported 36 endemic orchids.

Materials and methods

Intensive field explorations during 2010-2015 were carried out at different localities within the state of Maharashtra at frequent intervals. During field study various morphological details of orchid species were carefully noted in the field book along with flower colour, odour, habit and habitat, host species in case of epiphytes, local distributions etc. Photographs of whole plant along with close-ups of various plant parts (including floral parts) were captured with digital camera. Due to rarity of orchids in their natural habitats, no fresh material was collected by any of the authors for making herbarium specimens. The photographs were later identified with the help of available regional floras. The photographic identity of each taxon was further confirmed in consultation with authentic herbarium material deposited at HBARC (Herbarium of Bhabha Atomic Research Centre, Mumbai). On the other hand to find out detailed distributional records of individual species within the state, all previously collected orchid specimens which are housed at AHMA, BAMU, BLAT, BSI, CAL, MH and SUK were traced. Besides, virtual herbaria AMES, BM, K, GH, GOET, P and RENZ (acronyms according to Thiers, 2015) were also consulted. Distributional records of endemic species occurring outside the state of Maharashtra were mainly obtained from literature [e.g. Hooker (1888-90), Cooke (1907), Fischer (1928), Tiwari & Maheshwari (1963), Rathakrishnan & Chithra (1984), Rao (1986), Joseph (1987), Misra (2004), Kumar *et al.* (2001), Kumar & Manilal (2004), Fernando & Ormerod (2008), Misra *et al.* (2008), e-monocot (2015)] as well as from herbarium data. We decided to follow the recent taxonomic changes in orchid nomenclature, which have emerged as a result of phylogenetic analysis. The nomenclature and the taxonomic status of each taxon were further cross checked in IPNI (2015), The Plant List (2015), Tropicos (2015) and WCSP (2015). The conservation status of endemic orchid species were traced from Kumar *et al.* (2001) and Mishra & Singh (2001). Species recorded from the State are enumerated alphabetically in Appendix 1 along with habitat, phenology, and their distribution in the different divisions of Maharashtra. Herbarium specimens are cited in the following format: collectors surname followed by collector's number if available and if not with *s.n.*, followed by herbarium acronym in the bracket which is also sometimes suffixed with respective barcode number wherever available. In few cases we were unable to locate any herbarium specimens, in such cases reference associated with original report from the state is provided.

Results and discussion

The present study has revealed the occurrence of 122 taxa (119 species and 3 varieties) under 36 genera distributed in 2 subfamilies from the state of Maharashtra. The Konkan and Pune division showed to possess the highest number of taxa, *i.e.* 110 and 100 respectively, followed by Nashik (37), Nagpur (35), Aurangabad (29) and Amravati (27) (Fig. 3). The genus *Habenaria* Willdenow is the largest, represented by 21 species, followed by *Dendrobium* O.Swartz (13), *Peristylus* Blume (11), *Oberonia* Lindley (8), *Eulophia* R.Brown (7) and so on (Fig. 4). All currently reported genera are classified according to Chase *et al.* (2015). The number of species known from Maharashtra and the total number of species in the genus are indicated between brackets.

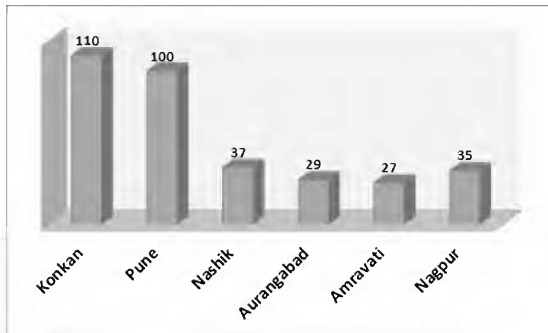


Fig. 3: Distribution of orchid species in different divisions of Maharashtra

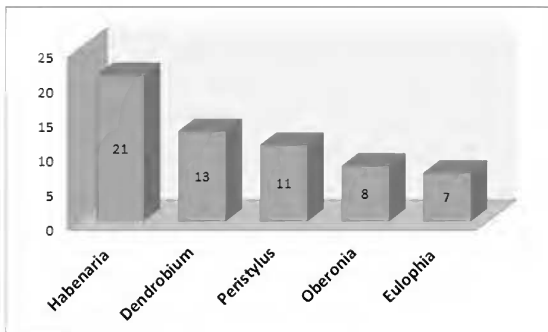


Fig. 4: Five largest genera in the Orchid flora of Maharashtra

Systematic overview

SUBFAMILY: ORCHIDOIDEAE

Tribe: Cranichideae

Subtribe: Goodyerinae

Genera: *Cheirostylis* Blume (2/53), *Zeuxine* Lindley (3/74).

Subtribe: Spiranthinae

Genus: *Spiranthes* L.C.M.Richard (1/34).

Tribe: Orchideae

Subtribe: Orchidinae

Genera: *Habenaria* Willdenow (21/835), *Pecteilis* Rafinesque (1/8), *Peristylus* Blume (11/103), *Satyrium* Linnaeus (1/86).

SUBFAMILY: EPIDENDROIDEAE

Tribe: Nervilieae

Subtribe: Nerviliinae

Genus: *Nervilia* Commerson ex Gaudicheau-Beaupré (4/67).

Subtribe: Epipogiinae

Genus: *Epipogium* Borkhausen (1/3).

Tribe: Arethuseae

Subtribe: Coelogyninae

Genera: *Pholidota* Lindley (2/39), *Thunia* Reichenbach f. (1/5).

Tribe: Malaxideae

Subtribe: Dendrobiinae

Genera: *Bulbophyllum* Thouars (3/1867), *Dendrobium* O.Swartz (13/1509).

Subtribe: Malaxidinae

Genera: *Liparis* L.C.M.Richard (4/426), *Malaxis* Solander ex O.Swartz (2/182), *Oberonia* Lindley (8/323).

Tribe: Cymbidieae

Subtribe: Cymbidiinae

Genus: *Cymbidium* O.Swartz (1/71).

Subtribe: Eulophiinae

Genera: *Eulophia* R.Brown (7/200), *Geodorum* G.Jackson (1/12).

Tribe: Collabieae

Genera: *Pachystoma* Blume (1/3), *Phaius* Loureiro (1/45).

Tribe Podochileae

Genera: *Conchidium* W.Griffith (4/10), *Pinalia* Lindley (1/105), *Porpax* Lindley (2/13).

Tribe: Vandaeae

Subtribe: Polystachyinae

Genus: *Polystachya* W.J.Hooker (1/234).

Subtribe: Aeridinae

Genus: *Acampe* Lindley (3/8), *Aerides* Loureiro (4/25), *Cleisostoma* Blume (1/88), *Cottonia* R.Wight (1/1), *Diplozentrum* Lindley (2/2), *Gastrochilus* D.Don (2/56), *Luisia* Gaudichieu-Beaupré (3/39), *Pteroceras* Hasskarl (1/27), *Rhynchostylis* Blume (1/3), *Smithsonia* C.J.Saldanha (3/3), *Vanda* R.Brown (2/73).

Ecology and Habitat

Out of the reported 122 taxa, 57 species are epiphytic, 62 taxa are terrestrial and 3 species are either epiphytic or lithophytic (Fig. 5). Most of the epiphytic species find *Mangifera indica* Linnaeus as their suitable host.

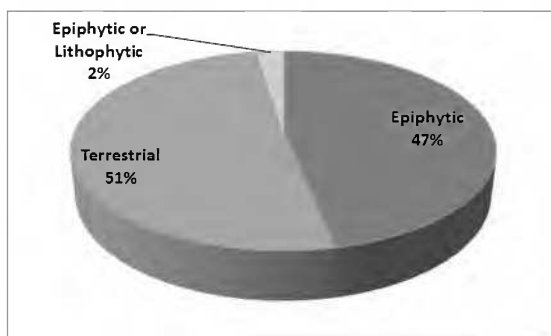


Fig. 5: Habitat specificity of the orchid flora of Maharashtra

Furthermore, the following 25 host trees also harbours a considerable number of epiphytic orchid species: *Acacia chundra* (Rottler) Willdenow, *Artocarpus heterophyllus* Lamarck, *A. integer* (Thunberg) E.D.Merrill, *Atalantia monophylla* A.P. de Candolle, *Careya arborea* Roxburgh, *Catunaregam spinosa* (Thunberg) Tirvengadam, *Citrus maxima* (J.Burman) E.D.Merrill, *Cleistanthus collinus* (Roxburgh) Bentham ex J.D.Hooker, *Dalbergia latifolia* Roxburgh, *Ficus benghalensis* Linnaeus, *F. racemosa* Linnaeus, *Heterophragma quadriloculare* (Roxburgh) K.Schumann, *Lagerstroemia lanceolata* N.Wallich,

Madhuca longifolia var. *latifolia* (Roxburgh) A.Chevalier, *Nothapodytes nimmoniana* (J.Graham) Mabberley, *Sapindus laurifolius* Vahl, *Schleichera oleosa* (Loureiro) E.D.Merrill, *Syzygium cumini* (Linnaeus) Skeels, *Tectona grandis* Linnaeus f., *Terminalia belirica* Wallich, *T. chebula* A.Retzius, *T. elliptica* Willdenow, *T. tomentosa* Wight & G.Arnott, *Memecylon umbellatum* N.Burman and *Wrightia tinctoria* R.Brown.

Endemism and phytogeographical affinities

Orchids of Maharashtra show a high degree of endemism. Out of 122 taxa reported 39 taxa (37 species and 2 varieties, ca. 32%) are endemic to India, 12 species (10%) are restricted to India and Sri Lanka and the remaining 71 taxa (58%) have a moderately wider distribution (Fig. 6 & 8). *Habenaria caranjensis* Dalzell and *Liparis dalzellii* J.D.Hooker are considered to be confined to the state of Maharashtra only, whereby the presence of the former remains doubtful, as the species has not been found since its description in 1850. The remaining 37 taxa listed in Appendix 2 are either restricted to the Western Ghats or their distribution further extends into other states of Peninsular India. The only exceptions are *Aerides maculosa* Lindley and *Eulophia ochreatea* Lindley. The distribution of the former extends into Jharkhand and Rajasthan, and the distribution of the later extends Jharkhand and West Bengal.

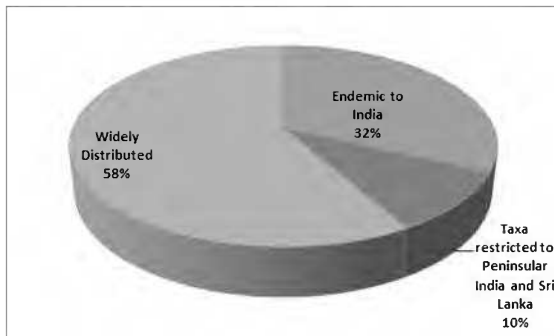


Fig. 6: Distribution pattern of the orchid flora of Maharashtra.

The distribution of *Aerides ringens* (Lindley) C.Fischer, *Cheirostylis parvifolia* Lindley, *Conchidium braccatum* (Lindley) Brieger, *Cottonia peduncularis* (Lindley) Reichenbach f, *Diplozentrum recurvum* Lindley, *Eulophia epidendreae* (J.Koenig ex A.Retzius) C.Fischer, *Habenaria longicorniculata* Graham, *Habenaria roxburghii* Nicolson, *Malaxis densiflora* (A.Richard) Kuntze, *Malaxis versicolor*

(Lindley) Abeywickrama, *Peristylus spiralis* A.Richard and *Pteroceras viridiflorum* (Thwaites) Holttum extends from Peninsular India to Sri Lanka.

Conservation status

Hitherto, the conservation status of the listed endemic orchid species has not been assessed by IUCN. However, Mishra & Singh (2001) regionally categorized six endemic species of Maharashtra under different threat categories: *Habenaria caranjensis* Dalzell as possibly Extinct, *Habenaria foliosa* A.Richard, *Habenaria multicaudata* Sedgwick and *Habenaria panchganiensis* Santapau & Kapadia as Endangered, *Habenaria suaveolens* Dalzell and *Peristylus richardianus* R.Wight as Critically Endangered. They considered two species, *Habenaria caranjensis* and *Habenaria panchganiensis*, to be endemic to state of Maharashtra. In fact, the later species was earlier assumed to be a distinct species, which was first instituted by Blatter & McCann (1932) as *Habenaria variabilis*. Santapau & Kapadia (1957) gave a new name for this species as *H. panchganiensis*. Recently, Jalal & Jayanthi (2013) synonymised it under *Habenaria suaveolens*.

On the other side Kumar *et al.* (2001) further regionally categorized the endemic orchids of Western Ghats into the following threat categories: 4 as Critically Endangered (CR), 14 as Endangered (EN), 12 as Vulnerable (VU) and 3 species under Near Threatened (NT) (Appendix 2 & Fig. 7).

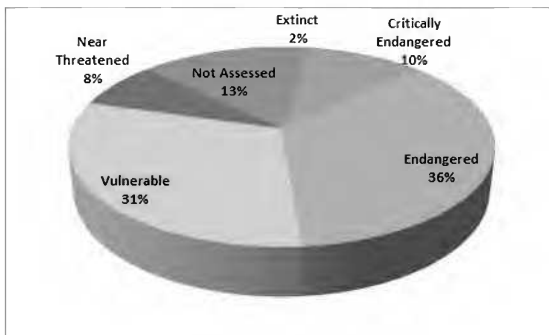


Fig. 7: Conservation status of endemic orchids of Maharashtra

However, the conservation status of *Eulophia ochreatea* Lindley, *Habenaria brachyphylla* (Lindley) Aitchison, *Habenaria hollandiana* Santapau, *Liparis dalzellii* J.D.Hooker and *Porpax jerdoniana* (Wight) Rolfe has not been assessed yet.

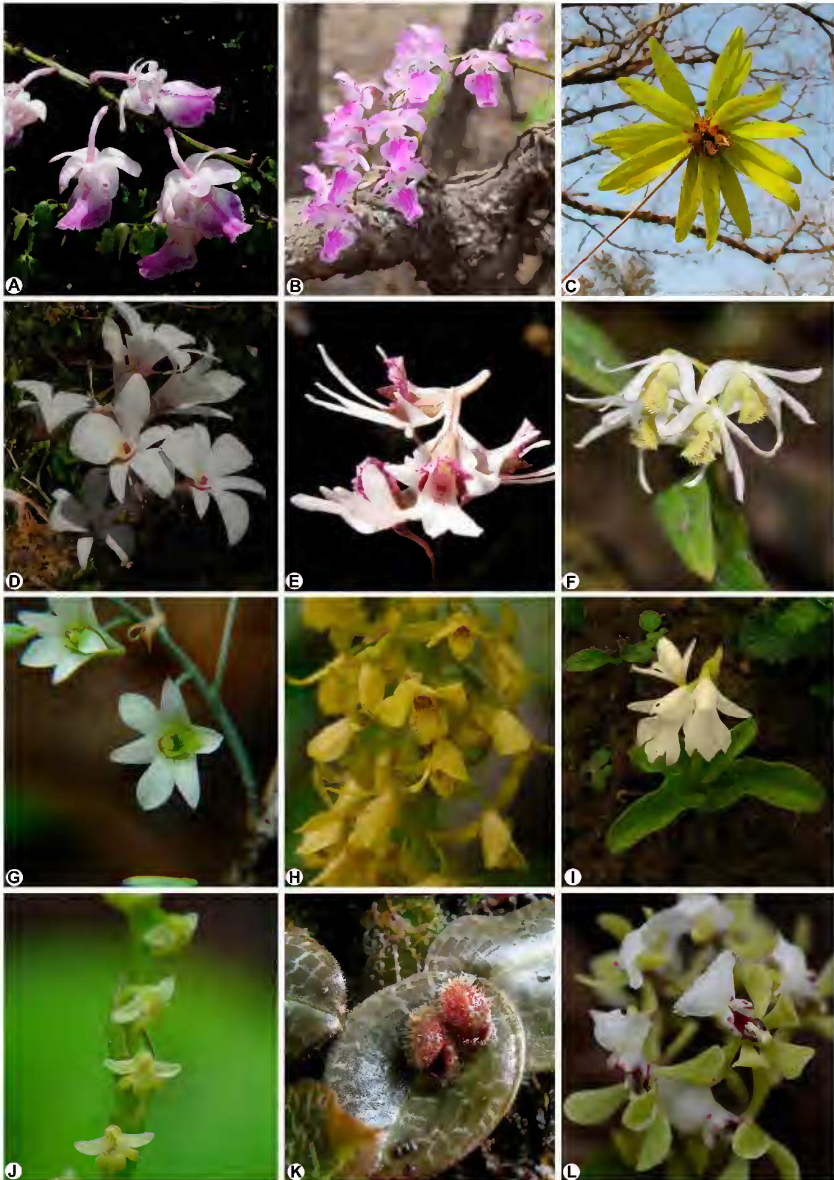


Fig. 8: Some endemic orchid species occurring in Maharashtra

A. *Aerides crisa*, B. *Aerides maculosa*, C. *Bulbophyllum fimbriatum*, D. *Dendrobium barbatulum*, E. *Dendrobium microbulbon*, F. *Dendrobium nanum*, G. *Dendrobium ovatum*, H. *Eulophia ochreatea*, I. *Habenaria suaveolens*, J. *Peristylus stocksii*, K. *Porpax jerdoniana*, L. *Smithsonia viridiflora*
 (A, C, D, E, F, I, K © P.K.Awale; B, G, H, J, L © Dinesh Valke)

Doubtful/excluded taxa

During the study it was found that the following 16 species viz. *Calanthe sylvatica* (Thouars) Lindley, *Chiloschista lunifera* (Reichenbach f.) J.J.Smith, *Coelogyne flaccida* Lindley, *Crepidium acuminatum* (D.Don) Szlachetko, *Dienia ophrydis* (J.Koenig) Seidenfaden, *Geodorum recurvum* (Roxburgh) Alston, *Goodyera procera* (Ker Gawler) W.J.Hooker, *Habenaria cephalotes* Lindley, *Luisia macrantha* Blatter & McCann, *Malaxis intermedia* (A.Richard) Seidenfaden, *Nervilia hispida* Blatter & McCann, *Oberonia proudlockii* King & Pantling, *Oberonia santapau* Kapadia, *Pomatocalpa decipiens* (Lindley) J.J.Smith, *Pomatocalpa maculosum* (Lindley) J.J.Smith and *Tropidia angulosa* (Lindley) Blume were reported by various authors from the state of Maharashtra either erroneously or doubtfully and in some cases with assumption. But hitherto no specimen of the above mentioned species has been collected from the state of Maharashtra, hence their occurrence in the state is still uncertain.

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Appendix 1

List of orchid species occurring in the wild in Maharashtra.

E=Epiphytic, L=Lithophytic, T=Terrestrial; s.n.=without collectors number, s.coll.=without collector

	Species	Habitat	Flowering	Distribution in Maharashtra					
				Konkan	Pune	Nashik	Aurangabad	Amravati	Nagpur
1	<i>Acampe ochracea</i> (Lindley) Hochreutiner	E	05-06	+					
2	<i>Acampe praemorsa</i> (Roxburgh) Blatter & McCann	E	03-05	+	+	+	+	+	+
3	<i>Acampe rigida</i> (Buchanan-Hamilton ex J.E.Smith) P.F.Hunt	E	04-09	+					
4	<i>Aerides crispa</i> Lindley	E	04-05	+	+	+			
5	<i>Aerides maculosa</i> Lindley	E	05-06	+	+	+		+	+
6	<i>Aerides multiflora</i> Roxburgh	E	04-05		+				
7	<i>Aerides ringens</i> (Lindley) C.E.C.Fischer	E	03-05	+	+				
8	<i>Bulbophyllum fimbriatum</i> (Lindley) Reichenbach f.	E	04-05	+	+				
9	<i>Bulbophyllum sterile</i> (Lamarck) Suresh	E	07-09	+	+				
10	<i>Bulbophyllum stocksii</i> (J.D.Hooker) J.J.Vermeulen, Schuiteman & de Vogel	E	02-03	+					
11	<i>Cheirostylis flabellata</i> (A.Richard) Wight	T	11	+	+				
12	<i>Cheirostylis parvifolia</i> Lindley	T	10-11	+	+				
13	<i>Cleisostoma tenuifolium</i> (L.) Garay	E	07-08	+					

Exsiccata / References
<i>fide</i> Kothari & Moorthy (1993). No specimen found.
Abraham 975 (HBARC-00000221), Dalzell 74 (K-000942341), Dutt 325 (HBARC-00000220), Thomas 635 (HBARC-00000219), Stocks & Law s.n. (K-000942339).
Almeida 2253 (BLAT).
Dutt 301 (HBARC-00000224)
Almeida 4417 (BLAT), Law 268 (K), Subramanyam s.n. (K).
Dutt 900 (HBARC-00000225).
Dalzell & Gibson s.n. (K), Woodrow s.n. (K).
Gavade 862 (BLAT), s.coll. s.n. (K- 000829987, 000829989).
Almeida s.n. (BLAT), Almeida 5232 (BLAT).
Stocks & Law s.n. (GH-00287630, GOET- 008707).
Bole 2244 (BLAT).
Almeida s.n. (BLAT), Bell s.n. (K).
Almeida 4948 (BLAT), Stocks & Law s.n. (K-000942275).

14	<i>Conchidium braccatum</i> (Lindley) Brieger	E/L	06-08	+	+		+		+
15	<i>Conchidium exile</i> (J.D.Hooker) Ormerod	E/L	10-12	+	+				
16	<i>Conchidium filiforme</i> (Wight) Rauschert	E	07-08	+	+	+			+
17	<i>Conchidium microchilos</i> (Dalzell) Rauschert	E/L	07-08	+	+	+			+
18	<i>Cottonia peduncularis</i> (Lindley) Reichenbach f.	E	04-05	+	+	+			
19	<i>Cymbidium aloifolium</i> (L.) O.Swartz	E	04-06	+	+				
20	<i>Dendrobium aphyllum</i> (Roxburgh) C.E.C. Fischer	E	03-05		+				
21	<i>Dendrobium aqueum</i> Lindley	E	09-10	+	+	+			+
22	<i>Dendrobium barbatulum</i> Lindley	E	04-05	+	+	+	+		+
23	<i>Dendrobium crepidatum</i> Lindley & Paxton	E	03-04	+	+				
24	<i>Dendrobium fimbriatum</i> W.J.Hooker	E	03-05	+	+				
25	<i>Dendrobium herbaceum</i> Lindley	E	09-11	+	+	+			+
26	<i>Dendrobium macraei</i> Lindley	E	06-08	+	+				
27	<i>Dendrobium macrostachyum</i> Lindley	E	05-06	+	+				
28	<i>Dendrobium microbulbon</i> A.Richard	E	12-03	+	+	+	+		+
29	<i>Dendrobium nanum</i> J.D.Hooker	E	10-12	+	+	+			+
30	<i>Dendrobium nodosum</i> Dalzell	E	07-08	+	+				
31	<i>Dendrobium ovatum</i> (L.) Kraenzlin	E	12-01	+	+	+			+
32	<i>Dendrobium peguanum</i> Lindley	E	10-12	+	+	+			+
33	<i>Diplozentrum congestum</i> Wight	E	06-09	+	+				
34	<i>Diplozentrum recurvum</i> Lindley	E	05-07	+	+				
35	<i>Epipogium roseum</i> (D.Don) Lindley	T	04-06		+				
36	<i>Eulophia dabia</i> (D.Don) Hochreutiner	T	12-01	+	+		+		+

Almeida 3154 (BLAT), Dalzell s.n. (K-000827409, 000260013), Law s.n. (K-000827407, 000827408), Stocks & Law s.n. (K-000827405, 000827406), s.coll s.n. (GH-00099152).
Gavde 587 (BLAT).
Dalzell s.n. (K- 000260025, 000881643), Law 166 (K-000883996).
Almeida 2039 (BLAT), Dalzell 167 (K-000883993), Law 91 (K-000883995), Stocks 27 (K-000883994), s.coll. s.n. (GH-00090173).
Almeida 4555 (BLAT), Almeida 1619A (BLAT), Dalzell s.n. (K), Ritachie 1424 (K), Woodrow s.n. (K). s.coll. s.n. (spirit) (K-71026.000).
Ritachie 1418 (K).
Dalzell s.n. (K), Dutt 867 (HBARC-00000229).
Kapadia 968, 1918 (BLAT), Santapau 12559 (BLAT).
Dalzell 32 (K-000894408), Law 3 (K-000894411).
Almeida 2515 (BLAT), Ritchie 717 (CAL).
Dutt 866, 899 (HBARC-00000226, 00000228).
Almeida 3158 (BLAT), Cook s.n. (CAL), Dalzell s.n. (BM), Gibson s.n. (K), Loddiges 153 (K-000894416), Rao 2336 (K).
Birdwood s.n. (K), Cook s.n. (K).
Almeida 1649 (BLAT).
Dalzell s.n. (K-000943915, 000943917), Gogel s.n. (REnz-10168), Law s.n. (K-000943916, 000943914), Ritchie 1413 (GH-00074986).
Law s.n. (K-000943910).
Stocks & Law 30 (K-001085563).
Gogel s.n. (REnz-10133), Loddiges s.n. (K-000894415), Stocks & Law s.n. (K-000894304).
Kapadia 724, 726 (BLAT).
Almeida 601 (BLAT).
<i>fide</i> Lakshminarasimhan (1996). No specimen found.
Sardesai 2035 (SUK).
Blatter 24693 (BLAT).

37	<i>Eulophia epidendreaea</i> (J.Koenig ex A.Retzius) C.E.C.Fischer	T	11-02	+	+				
38	<i>Eulophia graminea</i> Lindley	T	07-08		+				+
39	<i>Eulophia herbacea</i> Lindley	T	07	+	+				
40	<i>Eulophia ochreatea</i> Lindley	T	06-07	+	+	+		+	+
41	<i>Eulophia pratensis</i> Lindley	T	11-02	+	+		+	+	+
42	<i>Eulophia spectabilis</i> (Dennstedt) Suresh	T	05-06	+	+		+		+
43	<i>Gastrochilus calceolaris</i> (Buchanan-Hamilton ex J.E.Smith) D.Don	E	04-06	+					
44	<i>Gastrochilus flabelliformis</i> (Blatter & McCann) C.J.Saldanha	E	03-05	+	+				
45	<i>Geodorum densiflorum</i> (Lamarck) Schlechter	T	06-07	+	+	+		+	+
46	<i>Habenaria brachyphylla</i> (Lindley) Aitchison	T	08-09	+	+	+			
47	<i>Habenaria caranjensis</i> Dalzell	T	?	+					
48	<i>Habenaria commelinifolia</i> (Roxburgh) N.Wallich ex Lindley	T	08-09	+	+	+		+	+
49	<i>Habenaria crinifera</i> Lindley	T	08	+	+				
50	<i>Habenaria digitata</i> Lindley	T	07-10	+	+	+		+	+
51	<i>Habenaria diphylla</i> (Nimmo) Dalzell	T	07-09	+	+				
52	<i>Habenaria elwesii</i> J.D.Hooker	T	09-10		+				
53	<i>Habenaria foliosa</i> A.Richard var. <i>foliosa</i>	T	07-08	+	+			+	
54	<i>Habenaria foliosa</i> var. <i>foetida</i> (Blatter & McCann) Bennet	T	08-09	+	+			+	
55	<i>Habenaria foliosa</i> var. <i>gibsonii</i> (J.D.Hooker) Bennet	T	07-08	+	+	+	+	+	
56	<i>Habenaria fuscifera</i> Lindley	T	08-10	+	+	+			
57	<i>Habenaria grandifloriformis</i> Blatter & McCann	T	07-08	+	+	+	+	+	+

BGK-119300 (BLAT).
Yadav 4397 (K).
Cerejo-Shivkar 33 (BLAT), Stocks & Law s.n. (P-00390561).
Stocks & Law s.n. (GH-00099464, K-000838822, P-00390620).
Stocks 22 (K-000960018), Stocks & Law s.n. (GH-00099471, P-00390602).
Almeida 2681 (BLAT), Dalzell s.n. (K-000078323), Ritchie 708 (K), Stocks & Law s.n. (P-00390567, 00390568)
Almeida s.n. (BLAT).
Sardesai 2502 (SUK).
Dalzell s.n. (K), Stocks & Law s.n. (P-00387309).
Santapau 13097, 13129 (BLAT).
<i>vide</i> Dalzell (1850). No specimen found.
Almeida 3926 (BLAT), Law 302 (K), Dalzell s.n. (K), Stocks & Law s.n. (P-00405941).
Ritchie 1401 (AMES); Stocks & Law s.n. (P-00405989).
Gavade 13 (BLAT), Dalzell s.n. (CAL), Jain 5127 (CAL), Reddy 99213 (CAL), Stocks & Law s.n. (CAL, P-00426390).
Almeida 353, 433, 2946 (BLAT), Dalzell 1399 (GH-00099782), Singh 124334, 124538 (CAL), Stocks & Law s.n. (P-00426405, 00426406, 00426407).
Bachulkar 20349 (SUK).
s.coll. s.n. (K-000247473), Sardesai 1485 (SUK).
Cerejo-Shivkar 2 (BLAT), Sardesai 1555 (SUK).
Gibson s.n. (K-000247421), Stocks s.n. (K), Cook s.n. (K).
Almeida 3185 (BLAT), Renz 10110 (RENZ-10110.1, 10110.2)
Abraham 1124 (HBARC-00000232), Almeida 407 (BLAT), Dutt 203 (HBARC-00000231), Cook s.n. (K), Rao 32779 (CAL), Reddi 98283, 98673 (CAL), Stocks & Law s.n. (K), Thomas 208 (HBARC-00000235).

58	<i>Habenaria heyneana</i> Lindley	T	08-09	+	+	+	+		
59	<i>Habenaria hollandiana</i> Santapau	T	11-12		+			+	
60	<i>Habenaria longicorniculata</i> J.Graham	T	09-10	+	+	+	+	+	+
61	<i>Habenaria marginata</i> Colebrooke	T	07-08	+	+	+	+	+	+
62	<i>Habenaria multicaudata</i> Sedgwick	T	08-09		+			+	
63	<i>Habenaria plantaginea</i> Lindley	T	03-04	+	+	+		+	+
64	<i>Habenaria rariflora</i> A.Richard	T	07-08	+	+	+	+		
65	<i>Habenaria roxburghii</i> Nicolson	T	08-09	+	+		+	+	
66	<i>Habenaria stenopetala</i> Lindley	T	08-10	+	+				
67	<i>Habenaria suaveolens</i> Dalzell	T	07-09	+	+				
68	<i>Habenaria viridiflora</i> (Rottler ex O.Swartz) Lindley	T	08-12	+	+				
69	<i>Liparis dalzellii</i> J.D.Hooker	T	07-08	+					
70	<i>Liparis nervosa</i> (Thunb.) Lindley	T	07-09	+	+		+		
71	<i>Liparis odorata</i> (Willd.) Lindley	T	08-09	+					
72	<i>Liparis viridiflora</i> (Blume) Lindley	E	09-12	+					
73	<i>Luisia tenuifolia</i> Blume	E	03-04	+	+				
74	<i>Luisia trichorrhiza</i> (W.J.Hooker) Blume	E	07-08					+	+
75	<i>Luisia tristis</i> (J.G.Forster) J.D.Hooker	E	05-06	+	+	+			
76	<i>Malaxis densiflora</i> (A.Richard) Kuntze	T	07-08	+					
77	<i>Malaxis versicolor</i> (Lindley) Abeywickrama	T	06-08	+	+		+	+	
78	<i>Nervilia concolor</i> (Blume) Schlechter	T	05-06	+	+	+	+	+	+
79	<i>Nervilia crociformis</i> (Zollinger & Moritzi) Seidenfaden	T	08-09	+	+		+		
80	<i>Nervilia infundibulifolia</i> Blatter & McCann	T	05-06	+	+				
81	<i>Nervilia plicata</i> (Andrews) Schlechter	T	05-06	+	+	+			

Almeida 2819 (BLAT), Dalzell s.n. (K-000247458), Dalzell 14 (K-000061925), s.coll. s.n. (GH-00099740).
Woodrow s.n. (K-000247460).
Almeida 2833 (BLAT), Cook s.n. (K-000247437), Jacquemont 598 (K-000247438).
Almeida 3132 (BLAT), Dalzell s.n. (K), Law s.n. (K- 000247466, 000873766), Singh 124747 (CAL), Stocks 59 (K), Raghavan 64285 (CAL), Renz 10109 (RENZ-10109), Tilak s.n. (CAL), Vasavan 9905 (CAL).
Sardesai 197 (SUK).
Santapau 363, 910, 2490, 4993 (BLAT), Sardesai 199 (SUK).
Almeida 2553 (BLAT), Dalzell s.n. (K-000247424), Rao 131564 (BSI).
Dalzell s.n. (K), Ritchie 76 (K).
Dalzell s.n. (CAL), Stocks s.n. (K), Vartak 6789 (BLAT).
Almeida 3829 (BLAT), Dalzell s.n. (K-000247434, 000247435), Kulkarni 10630 (BSI), Rao 77909 (BSI).
Sardesai 4245 (SUK).
Dalzell 47 (K-000387793).
Almeida 515 (BLAT), Gavade 1475 (BLAT).
Almeida 2792 (BLAT), Stocks & Law s.n. (K-000718672).
Rao 95193 (CAL).
Kapadia 2912, 2915 (BLAT).
Govekar 197, 764, 967 (BAMU), Muratkar 2433 (BAMU).
Almeida 2784, 3703 (BLAT).
Gavade 441 (BLAT), Stocks & Law s.n. (GH-00101677).
Almeida 5024 (BLAT).
Almeida 2486 (BLAT), Bell s.n. (K).
Almeida 2236 (BLAT).
Cook s.n. (K), Santapau s.n. (K), Young s.n. (BM).
Kapadia 1464 (BLAT), Law s.n. (K).

82	<i>Oberonia bicornis</i> Lindley	E	10	+					
83	<i>Oberonia brunoniana</i> Wight	E	02-03	+	+		+		
84	<i>Oberonia ensiformis</i> (J.E.Smith) Lindley	E	08-09	+					
85	<i>Oberonia falconeri</i> J.D.Hooker	E	09-10	+				+	+
86	<i>Oberonia mucronata</i> (D.Don) Ormerod & Seidenfaden	E	08-09	+					
87	<i>Oberonia platycaulon</i> Wight	E	12	+					
88	<i>Oberonia recurva</i> Lindley	E	11-02	+	+		+		
89	<i>Oberonia verticillata</i> Wight	E	07-08	+					
90	<i>Pachystoma pubescens</i> Blume	T	02-03		+				
91	<i>Pecteilis gigantea</i> (J.E.Smith) Rafinesque	T	09-10	+	+	+	+		
92	<i>Peristylus affinis</i> (D.Don) Seidenfaden	T	08	+	+				
93	<i>Peristylus aristatus</i> Lindley	T	08-09		+				
94	<i>Peristylus constrictus</i> (Lindley) Lindley	T	06-07					+	+
95	<i>Peristylus densus</i> (Lindley) Santapau & Kapadia	T	08-10	+	+	+	+		
96	<i>Peristylus gardneri</i> (J.D.Hooker) Kraenzlin	T	09	+	+				
97	<i>Peristylus goodyeroides</i> (D.Don) Lindley	T	08	+	+				
98	<i>Peristylus lawii</i> Wight	T	07-08	+	+				
99	<i>Peristylus plantagineus</i> (Lindley) Lindley	T	07-08	+	+		+	+	+
100	<i>Peristylus richardianus</i> Wight	T	09-10	+	+				
101	<i>Peristylus spiralis</i> A.Richard	T	07-08	+					
102	<i>Peristylus stocksii</i> (J.D.Hooker) Kraenzlin	T	07-08	+	+	+	+	+	+
103	<i>Phaius tankervilleae</i> (Banks) Blume	T	02-11	+	+				
104	<i>Pholidota imbricata</i> Lindley	E	06-07	+	+				
105	<i>Pholidota pallida</i> Lindley	E	06-07	+	+				
106	<i>Pinalia mysorensis</i> (Lindley) Kuntze	E	07-08	+	+				
107	<i>Polystachya concreta</i> (N.Jacquín) Garay & H.R.Sweet	E	06	+					

Gavade 61, 634 (BLAT).
Sardesai 7 (SUK).
Das 3222, 3203 (BLAT).
Ryan 65 (CAL), Mahajan 6957 (CAL), Law s.n. (K-000387738).
Santapau 16030 (BLAT).
s.coll. 19 (K-000387718).
Almeida 3210, 5056A (BLAT).
<i>fide</i> Shah & Badrinath (1985). No specimen found.
Acland 1353 (BLAT), Dalzell s.n (K), Ritchie 1432 (K).
Almeida 2764, 3228 (BLAT), Law 262 (K), Meebold 9885 (MH), Stocks & Law s.n. (K).
Almeida 4959 (BLAT).
Sardesai 218, 201 (SUK).
<i>fide</i> Mudaliar (1991).
Almeida 3188, 3176 (BLAT), Hooker 13 (GH-00287398, 00083715), Law 13 (K-000247496).
Almeida 3150 (BLAT).
Beddome s.n. (BM), Rimmo s.n. (K).
Almeida 2806 (BLAT), Law s.n. (K- 000387585), Stocks & Law s.n. (GOET- 008455, 008456).
Almeida 364, 2483 (BLAT), Dalzell s.n. (K- 000387509, 000387510), Reddi 99361 (CAL), Ritchie 1396 (K), Sharma 167889 (K), Singh 125052 (CAL).
Almeida 334 (BLAT).
Stocks & Law s.n. (K).
Almeida 1673 (BLAT), Ritchie 1398 (K-000387525), Stocks & Law s.n. (K-000974268).
Dutt 398 (HBARC-00000236), Kapadia 1842 (BLAT).
Almeida 4895 (BLAT).
Almeida 4895 (BLAT).
Stocks s.n. (P-00403540), Stocks & Law s.n. (GH-00099315, GOET-013852).
<i>fide</i> Gammie (1908). No specimen found.

108	<i>Porpax jerdoniana</i> (Wight) Rolfe	E	06-07	+	+				+
109	<i>Porpax reticulata</i> Lindley	E	06-07	+	+	+	+		
110	<i>Pteroceras viridiflorum</i> (Thwaites) Holttum	E	05-06	+					
111	<i>Rhynchosstylis retusa</i> (L.) Blume	E	05-06	+	+	+	+	+	+
112	<i>Satyrium nepalense</i> D.Don	T	09-10	+	+				
113	<i>Smithsonia maculata</i> (Dalzell) C.J.Saldanha	E	05	+	+				
114	<i>Smithsonia straminea</i> C.J.Saldanha	E	05-06	+					
115	<i>Smithsonia viridiflora</i> (Dalzell) C.J.Saldanha	E	05-06	+	+	+			
116	<i>Spiranthes sinensis</i> (C.Persoon) Ames	T	03-04	+	+				
117	<i>Thunia alba</i> var. <i>bracteata</i> (Roxburgh) N.Pearce & P.J.Cribb	E	07-08	+	+				
118	<i>Vanda tessellata</i> (Roxburgh) W.J.Hooker ex G.Don	E	06-07	+	+		+	+	+
119	<i>Vanda testacea</i> (Lindley) Reichenbach f.	E	04-05	+	+	+	+		+
120	<i>Zeuxine gracilis</i> (Breda) Blume	T	02-03		+				
121	<i>Zeuxine longilabris</i> (Lindley) Trimen	T	02-03	+	+				
122	<i>Zeuxine strateumatica</i> (L.) Schlechter	T	01-03	+	+	+	+	+	+

Appendix 2: Endemic orchids outside of Maharashtra : distribution and conservation status.

RRLC = Regional Red List Category by Kumar et al. (2001).

CR = Critically Endangered

EN = Endangered

VU = Vulnerable

NT = Near Threatened

NA = Not Assessed.

Almeida 2543 (BLAT), Law s.n. (K-001085617).
Gavade 1776 (BLAT).
Almeida 1621 (BLAT).
Almeida 850, 2253 (BLAT).
Almeida 2483 (BLAT).
Dalzell s.n. (K-000891594).
Datar 25345, 25346 (AHMA).
Almeida 1461 (BLAT), Dalzell s.n. (K-000891593), Dalzell 1427 (GH-00101590).
Rukminibai 1916 (BLAT).
Dalzell s.n. (K).
Barber 2531 (K), Subramanyam 4730 (MH).
Law & Hooker 183 (K-000895722), Loddiges 1567 (K-000895723), Renz s.n. (RENZ-10265), Ritchie 1433 (K).
Gavade 2441 (BLAT), Sardesai 2045 (SUK).
Stocks & Law s.n. (GH-00101799).
s.coll. s.n. (K-000942798).

Gu = Gujarat

M = Madhya Pradesh

C = Chhattisgarh

O = Orissa

A = Andhra Pradesh

Ka = Karnataka

Go = Goa

Ke = Kerala

T = Tamil Nadu

	Species	Gu	M	C	O	A	Ka	Go	Ke	T	RRLC
1	<i>Aerides crispa</i>	+					+	+	+	+	VU
2	<i>Aerides maculosa</i>	+		+	+	+	+	+	+	+	EN
3	<i>Bulbophyllum fimbriatum</i>						+	+	+	+	EN
4	<i>Bulbophyllum stocksii</i>						+		+	+	CR
5	<i>Conchidium exile</i>						+	+	+	+	VU
6	<i>Conchidium filiforme</i>						+		+	+	NT
7	<i>Conchidium microchilos</i>						+	+	+	+	VU
8	<i>Dendrobium aequum</i>					+	+		+	+	VU
9	<i>Dendrobium barbatulum</i>	+					+	+	+	+	VU
10	<i>Dendrobium microbulbon</i>	+					+	+	+	+	EN
11	<i>Dendrobium nanum</i>						+		+	+	EN
12	<i>Dendrobium nodosum</i>						+		+	+	VU
13	<i>Dendrobium ovatum</i>	+				+	+	+	+	+	VU
14	<i>Diplocentrum congestum</i>						+		+		EN
15	<i>Eulophia ochreatea</i>	+		+	+	+	+		+	+	NA
16	<i>Eulophia pratensis</i>	+					+		+	+	NT
17	<i>Gastrochilus flabelliformis</i>						+	+	+		EN
18	<i>Habenaria brachyphylla</i>				+		+		+	+	NA
19	<i>Habenaria caranjensis</i>										EX
20	<i>Habenaria elwesii</i>						+		+	+	CR
21	<i>Habenaria foliosa</i> var. <i>foliosa</i>				+		+		+	+	VU
22	<i>Habenaria foliosa</i> var. <i>foetida</i>	+	+	+	+		+				CR
23	<i>Habenaria foliosa</i> var. <i>gibsonii</i>				+		+				CR
24	<i>Habenaria grandifloriformis</i>	+		+	+		+		+	+	VU
25	<i>Habenaria heyneana</i>						+	+	+	+	NT
26	<i>Habenaria hollandiana</i>					+	+			+	NA
27	<i>Habenaria multicaudata</i>						+	+	+	+	VU
28	<i>Habenaria rariflora</i>					+	+		+	+	VU
29	<i>Habenaria suaveolens</i>						+				EN
30	<i>Liparis dalzellii</i>										NA
31	<i>Oberonia brunoniana</i>					+	+	+	+	+	VU
32	<i>Oberonia platycaulon</i>						+		+	+	EN
33	<i>Oberonia verticillata</i>						+		+	+	EN
34	<i>Peristylus stocksii</i>	+					+	+		+	EN
35	<i>Pinalia mysorensis</i>						+		+	+	EN
36	<i>Porpax jerdoniana</i>						+	+	+	+	NA
37	<i>Smithsonia maculata</i>						+		+	+	EN
38	<i>Smithsonia straminea</i>						+		+		EN
39	<i>Smithsonia viridiflora</i>						+		+		EN